THE VARIATIONS OF GLACIERS. VII.[1]

THE following is a summary of the *Sixth Annual Report* of the International Committee on Glaciers:[2]

RECORD OF GLACIERS FOR 1900.

Swiss Alps.—The retreat of the past few years is becoming more marked. There is but one glacier, the Boveyre (in the Valais), which is certainly advancing; since 1892 it has advanced 113 meters. A smaller number than last year are doubtful, and a larger number are certainly retreating. Reports have been received from eighty-two glaciers.[3]

Eastern Alps.—The Vernagt glacier, in the Oetzthal, continues its remarkable advance, and has gained 150 meters since last year. It has united with its neighbor, the Guslar glacier, and is ploughing up its terminal moraine. The ice is seventy meters thick at the point where the glacier ended in 1895; and its velocity, at one section, where it has been frequently measured, though somewhat less than it was a year or two ago, is still about twelve times as great as it was before the beginning of the advance. Measures on the Hintereis glacier gave a velocity from the middle of July to the middle of September exactly equal to the mean for the year, suggesting a constant rate for all seasons of the year. Of the other glaciers in the same general region some show a slight advance and some a slight retreat. The most easterly glaciers, which are in the Ankogl group, present a remarkable condition; of three observed, one has retreated about three meters in the last two years, and the other two have advanced about twenty meters.[4]

[1] The earlier reports appeared in the JOUR. GEOL., Vol. III, pp. 278–88; Vol. V, pp. 378–83; Vol. VI, pp. 473–76; Vol. VII, pp. 217–25; Vol. VIII, pp. 154–59; and Vol. IX, pp. 250–54.

[2] *Archives des sciences phys. et. nat.*, Vol. XII, pp. 56–69, 118–131, Geneva, 1901.

[3] Report of Professor Forel and M. Muret.

[4] Report of Professor Finsterwalder.

Italian Alps.—The glaciers of the eastern Italian Alps show a small retreat; some glaciers southwest of Savoy are retreating more rapidly; but the snow seems to be increasing in the Maritime Alps to the west, and two of the glaciers there have advanced several meters.[1]

Swedish Alps.—The summer of 1900 was very cold, with extremely large snowfalls. The glaciers of Lapland, which were the only Swedish glaciers visited, have not changed since the preceding year.[2]

Norwegian Alps.—According to Schöning, the years when grain has not ripened in Norway were 1600–2, 1632–34, 1685–87, 1695–97, 1740–42. These dates follow pretty closely the dates of cold, damp periods in Europe as given by Brückner, and the dates of advance of the glaciers of the Alps as given by Richter. In Norway, however, it is only for the last of these dates that we have any precise information regarding the variations of the glaciers. In 1742–43 the Nigard (Jostedal) advanced about forty-three meters; in 1748 it began to retreat slowly. Other glaciers showed similar variations. There was, in general, a great advance in the eighteenth century, preceded by a very marked retreat; since then there has been a small retreat on which have been superposed many minor variations. At present the glaciers of Jostedal seem to be advancing.

The glaciers of Jotunheim were, in general, advancing in the summer of 1898; since then they have been retreating.[3]

Arctic regions.—M. Charles Rabot has given a very complete account of the observations which have been made on the glaciers of the Arctics and neighboring regions, with full references to the literature, which will be of great service to future observers. His general results as to the variations of these glaciers are:

1. Before the eighteenth century, the glaciers were much less extensive than they are today, and this minimum lasted for several centuries.

[1] Report of Professor Porro. [2] Report of Dr. Svenonius.

[3] Report of Dr. Oyen, which is condensed from a very detailed account of the glaciers of Norway published in English in *Nyt Magazin for Naturvidenskaberne*, Vol. XXXIX, pp. 73–116, Christiania, 1901.

2. During the eighteenth century an enormous advance took place, greater than an ordinary variation. The glaciers invaded territory which they had never occupied during the present [geological] period. This advance was general over all the northern hemisphere.

3. During the nineteenth century the variations have not been uniform. In some regions there has been a considerable advance followed by a slight retreat; whereas, in others, the glaciers, after remaining at a maximum up to the early part of the century have since experienced a small diminution. Nowhere has the retreat been so great as in the Alps during the last fifty years.[1]

Spitzbergen.—Baron de Geer has made a map of the southern and central parts of Spitzbergen which gives an excellent idea of the large glaciers of that region. Professor Nathorst has also described and figured some of these glaciers.[2]

Greenland.—The Swedish expedition of 1899 made a large map of northeastern Greenland; which shows a great number of glaciers, including the Waltershausen which has a breadth of 13 kilometers where it ends in the fiord. Dr. Steenstrup has described a number of small glaciers occupying depressions on the mountain sides on the western coast, which are frequently entirely covered with débris; they seem to be the remnants of a greater glaciation.[3]

Canada.— All the glaciers observed continue to retreat at an increasing rate. The Victoria glacier (Alberta) has diminished slightly. Its velocity measured at two points amounts to 130 feet per year. The Asulkan glacier (B. C.) has retreated 24 feet; the Illicillewaet has retreated 64 feet and has become thinner and

[1] "Les Variations de Longueur des Glaciers dans les régions arctiques et boréales," *Archives des sciences phys. et. nat.*, Geneva, 1897, 1899, and 1900. These papers were more fully reviewed in *Science*, December 13, 1901. It is interesting to note that the same order of events has been followed by the glaciers of southeastern Alaska, namely, a long period of small extension, then a short period of great advance, and finally a general retreat, which has been going on for the last hundred years or more. "Studies of Muir Glacier," *Nat. Geog. Mag.*, 1892, Vol. IV, pp. 38, 39. "Glacier Bay and Its Glaciers," *Sixteenth Ann. Rept. U. S. Geol. Surv.*, 1896, pp. 438–40.

[2] G. DE GEER, *Om gradmatningsnatels framförande öfver södra om mellersta Spitzbergen*, Ymer, 1900; A. G. NATHORST, *Twå somrar i norra ishafvet*, Ymer, 1900.

[3] Report of Professor A. Nathorst.

narrower. About 1,500 feet from the end a velocity of about 194 feet per year was measured.[1]

Caucasus.— A number of glaciers in the southeastern part of the chain are retreating, and a number of glacial lakes have been discovered there. The glaciers of the central part of the chain are also found to be retreating. Two glaciers on Mt. Ararat give evidence of retreat.

Siberia.— Professor Sapojnikov has published a finely illustrated book on "The Katoun River and its Tributaries" (Tomsk 1901) in which he gives a detailed account of the glaciers draining into that river. Some of the glaciers he has mapped, others he has only photographed. They are all retreating.

Turkestan.— A number of glaciers have been recently discovered in Turkestan, all of which give distinct evidences of being in retreat.[2]

Himalaya.— The great glaciers of Kanchinjanga are from 15 to 17 miles long, and descend to about 13,000 feet above sea level. They are slowly retreating. The Anglo-Indian surveyors formerly restricted the name glacier to the clear ice between the névé fields and the lower moraine-covered portions; many erroneous ideas regarding these glaciers have thus been introduced.[3]

REPORT ON THE GLACIERS OF THE UNITED STATES FOR 1901.[4]

The narrative and general papers of the Harriman Alaska expedition have been published in two handsome volumes, which contain many excellent illustrations of the glaciers. The general description of the glaciers is written by Mr. John Muir, and he notes that at the time of his first visit in 1879, the two branches of the Grand Pacific glacier and the Johns Hopkins glacier were united and presented a single ice-front; the Hugh Miller and the Charpentier glaciers were also united at that time. He estimates

[1] Report of Messrs. G. and William S. Vaux, Jr.

[2] Report of Professor Mouschketov.

[3] Report of Mr. D. W. Freshfield.

[4] A synopsis of this report will appear in the *Seventh Annual Report of the International Committee.* The report on the glaciers of the United States for 1900 was given in the JOUR. GEOL., Vol. IX, pp. 252–54.

that the Hugh Miller and the Muir glaciers have receded about two miles in the last twenty years; the Grand Pacific and the Johns Hopkins about four miles; and the Geikie, Rendu, and Carroll from seven to ten miles.

Glacier Bay, Alaska, remains so full of floating ice resulting from the earthquake of September, 1899, that steamers were unable to approach Muir glacier last summer. However, on December 31, 1901, one of the steamers made a special effort to approach the glacier and succeeded in reaching a point about a mile from the former ice wall. The captain of the steamer reports that from this point onwards the inlet was closely packed with large bergs, and that the true end of the glacier could not be distinguished. The shores of the inlet were thickly covered with large stranded icebergs fifty or sixty feet high.

Last summer the author visited the glaciers of Mt. Hood and Mt. Adams. These two volcanic cones in the northern part of the Cascade Range support eight and nine glaciers respectively. The heights of the lateral, and in some cases of the terminal, moraines show that the glaciers have been larger at no distant date, and that they are now retreating. Some of the moraines are still underlain by ice. But few of the glaciers occupy valleys; many of them lie on the mountain slopes supported by their lateral moraines, and it is evident that they have eroded their beds very little. Stations were established at the ends of several glaciers, and future variations will be shown by photographs to be taken from these stations.

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